**Q1:** How do you define the velocity in congestion situations? (Allan)

**Key Words:** Velocity, Congestion Situations

**A:** We would define that equals to infinity, but we defined congestion state to solve the problem.

**Q2:** What do the types of variables mean? (Lyra)

**Key Words:** Types of Variables

**A:** Constant A refers to the static constants that reflect properties of the model; Constant B refers to the variables solely dependent on an aircraft or a strategy; Variables describe properties of passengers and will vary under different initial sequences of passengers.

**Q3:** Who are backup passengers in your multi-aisle model? Raymond

**Key Words:** Backup Passengers, Multi-Aisle

**A:** Backup passengers are designed to prevent the empty cells caused by seated inner-group passengers from occurring, because they can fill in the blocks soon afterwards and thus ensure the parallelity and efficiency. They are inner-group passengers who board straight after some outer-group passengers.

**Q4:** Could you please explain velocity? (Allan)

**Key Words:** Velocity

**A:** (R1) When we consider that the velocity in a specific cell remains constant, then the velocities can be seen as points on the continuous velocity function, as shown on the graph. Considering that the cell is relatively short, there wouldn't be much inaccuracy; thus, the assumption is plausible.

**Q5:** Why do you take visibility range ? (Raymond)

**Key Words:** Visibility Range, Not in SA

**A:** (R2) We take as the visibility range of passengers. The first reason is that is realistic. And the second is that we need to make sure the time spent in a cell contains iinteger timesteps. So a second should contain at least time steps. If taken as , the basic time step can be taken as , simplifying our calculating procedures.

**Q6:** What’s the use of using matrixes to describe passenger states? (Allan)

**Key Words:** Matrix, Passenger States

**A:** (R3) We use matrixes to describe the states of passengers. This is because it can mathematically describe the originally abstract states into the simple three matrixes, making the model easier to understand and the calculation simpler. Besides this, we used a constant transforming matrix to calculate the state matrixes according to the pre-existing ones, ensuring linearity.

**Q7:** What did you do to simplify your model? (Allan)

**Key Words:** Model Simplification

**A:** (R4) We conducted some improvements on our model to make it direct and straightforward. First, we used multiple variables to describe our model, which prevented interference of irrelevant numeric coefficients. We also avoided excessive intermediate variables with algebraic simplifications in our model. For example, constants are adopted in the final conclusive equation to replace those invariant values concerning a specific type of aircraft. Finally, this part lays the foundation for the linear properties that will be extensively utilised in the future.

**Q8:** Why is the mathematical part/simplification so important in your model? (Allan)

**Key Words:** Mathematical Part, Simplification, Importance

**A:** (R5) The main work in our first model is mathematical deduction. Indeed, there are multiple purposes for putting emphasis on this part. First, by describing the different situations using formulas, we can make our model accurate and variable-based, which is very important in the modelling process. Also, optimization will also be aided with simple formulas rather than complex computer-based processes. Therefore, we are convinced to say that this deduction process plays a vital role in our model.

**Q9:** Why is the calculation of like that? (Raymond)

**Key Words:** Calculation of , Matrix

**A:** (R6) For the calculation of , or number of time steps that passengers are moving, according to the definition of the matrix , we only need to accumulate the elements, thus the formula is correct. This formula can ensure linearity.

**Q10:** Why did you introduce parallelity? (Eason)

**Key Words:** Parallelity

**A:** (R7) Instead of being a concept that just appeared out of nowhere, parallelity has sound foundations which are mainly aided by the linearity of the previous calculations after algebraic simplifications. It also ensures its equivalence with the original time-minimizing task. We know that equivalent conversions are usually made to alter the problem’s external modality but maintain its inherent structure with equivalence, and that’s exactly what parallelity does. It converts the complex multi-variable formula of total time into a simple univariate optimisation of parallelity, which significantly eases the burden of exhaustively searching all the cases.

**Q11:** at’s the best disembarking strategy? / How is disembarking similar to boarding? (Raymond)

**Key Words:** Disembarking, Similarity to Boarding

**A:** (R8) In our presentation, we’ve already introduced two aspects of *optimal* – the dissatisfaction index and parallelity. Coincidentally, disembarking can meet both requirements at the same time. We used the adjustment method to achieve this, keeping parallelity at the optimum. Since the first two factors of dissatisfaction remain constant for any optimal scheme for time, we only need to minimise the standard variance of the boarding time of same-row passengers. In the end, we got the optimal disembarking scheme, as shown before.

**Q12:** Why do you take 1, 250 and 10 as the weights? (Raymond)

**Key Words:** Satisfactory Index, 1, 250 and 10, Not in SA

**A:** (R9) When defining the total dissatisfaction index, we consider three factors: queueing, offering seats and same-row passengers separation. The third factor is that some family or fellow passengers may be split. 1 is for standardisation and the other two are to unite the magnitudes and importance, preventing the total index from tending to one of them, thus making the ultimate dissatisfaction index of all passengers linear and plausible.

**Q13:** How did you conduct SA? (Eason)

**Key Words:** SA General

**A:** (R10) When analysing the sensitivity of each plan, we innovatively used goodness of fit as an index, as it can reflect the regularity of the data and thus show the sensitivity. (R11) When generating the data of the discompliance index, we used the Sigmoid Model. We use the sigmoid model because it’s commonly used in statistics and its usage can be determined by nature of function. (R12) The result is that Random is far more sensitive than the other two strategies when measuring standard variance and timestep. (R13) When considering the overall time and average, the result is similar. (R14) For queue jumping, we found that both Methods are Sensitive which makes a Big Impact on Total Results, as shown on the graph, the points are irregularly distributed. (R15) In terms of passenger reduction, random boarding is the most sensitive (with furthest distribution of points) while back-to-front is not so sensitive.

**Q14:** How did you apply the model to TETA and FW? How did you come up with the idea to divide TETA and FW into blocks? (Raymond)

**Key Words:** Section Division, TETA, FW

**A:** (R16) For multi-aisle aircrafts as TETA and Flying Wing, we decide to divide them into smaller parts similar to the ordinary one-aisle aircraft because we want to unify our models. To be specific, we divide these aircrafts into smaller blocks according to aisles the seats are near. This is plausible because these aisles don’t intersect with each other, thus passengers in different blocks wouldn’t disturb each other. And for the optimal strategy, it’s obvious that we need to ensure both the efficiency of in-group boarding and between-group sequences. As a result, our work can be reduced to finding a best between-group sequence, as we can use the strategy shown before when deciding in-group sequences.

**Q15:** Did you predict the efficiency of each strategy before simulating? (Eason)

**Key Words:** Prediction, Mathematics, Simulating, Parallelity

**A:** Yes, we've done this using parallelity. This is what parallelity is used for: It uses mathematics to turn a “linear calculation” into a “simulation formula”, and proves that time is related with parallelity. Therefore, there is no need to use simulation while designing a plan, we can use parallelity to understand the best process simply.

**Q16:** I didn't see you elaborate on the actual *programming* part (except from those algorithms), but it has been shown on the flow chart. So what's the role of programming in your model? (Allan)

**Key Words:** programming, computer-based simulation

**A:** Firstly, we'd like to clarify that unlike real *simulations*, our programming focuses on accurately calculating a specific case rather than enumerating all the cases by brute force. Actually, even enumerating in such detail takes tremendous time. What we did, as mentioned before, were mathematically finding the optimal solution to minimizing the time steps and only operating on that possible optimum case.

The second critical point is that our programming can efficiently treat specific cases. Instead of again recursive calculating all variables within every time step, we use the previously deducted mathematical formulae and only calculate the velocities of passengers. To conclude, the programming work only conducts the algorithms and the irreducible formulae.

**Q17:** Why are there so many variables in your essay. / Why didn't I see explanations or calculations for some of the variables? (Allan)

**Key Words:** Too Many Variables

**A:** We've mentioned that due to limits on length, we only focused on the core of problem, so we omitted trivial calculations of the less important variables, such as . In spite of these, we still remained the interconnections between variables to be logical.

**Q18:** What does One-dimensional meshed finite element analysis mean? (Raymond)

**Key Words:** one-dimensional

**A:** As the passengers can only walk in the aisle or in their row (getting seated or offering seats), and they can't get from one row of seats to another, the structure of the aircraft is (for the passengers' motion) like a tree, with the cells as its nodes, which is a kind of One-dimensional meshed finite element analysis.

**Q19:** What is the unit of variables in your model? Why don't you have a unit for neither time nor velocity? (Eason)

**Key Words:** unit

**A:** (P7) We simply define time as partitions of basic time steps, which removes the unit from the time. For velocity, we define the time t spent to move the length of a cell d. To be precise, we first use d (m) / (over) v (m/s) to get realistic time, and then divides it by tau\_0, which gets a velocity with the same unit of time. or simply, 1.

**Q20:** So why did you think of these two matrixes. Did it just come out of nowhere? (Allan)

**Key Words:** Matrix

**A:** There are mainly two reasons for this The first is that these matrixes have clear actual meanings. To be specific, the (1,1) element of the matrix represents whether a passenger is in the moving state, and the (2,2) element indicates the reason for not moving. This can be especially helpful when we calculate indicators such as $l\_i(A)$ afterwards. The second reason is that they follow the ideal recursive pattern as we want. With these two factors combined, we believe the selection of these matrixes comes after close inspection.